# AbstractID: 5534 Title: A new dose optimization algorithm for Adaptive Radiation Therapy

**Purpose:**

Current radiation treatment plans do not adapt to errors (and other deviations from the target dose distribution) in already delivered fractions. We assume that the dose actually delivered (including any errors) is known after its delivery. We devise a dynamic control algorithm compensating for these errors by adapting the plan for the current fraction.

**Method and Materials:**

We wrote MATLAB code that models treatment of a 2D phantom using the beamlet model. We used SNOPT (a commercial SQP optimization code) to select beamlet weights that minimize the weighted quadratic deviation from some desired dose. We also apply our algorithm to a head and neck case.

Suppose the prescription dose is $D^*$ over $N$ fractions; $D_i^*$ is the dose planned for fraction $i$; and $D_i$ is the dose actually delivered in fraction $i$. Our baseline (algorithm) chooses for fraction $i$ the feasible plan, $D_i^*$, that minimizes the weighted quadratic deviation from $D^*/N$. Our adaptive algorithm selects for fraction $k$ the feasible plan $D_k^*$ that minimizes the weighted quadratic deviation from $D^*(k/N)-D_1-...-D_{k-1}$. Simulation determines the delivered dose $D_i$ from the anticipated dose $D_i^*$ by adding noise and incorporating setup error (translation and rotation of the patient) and tissue distortion caused by small organ motion. We compare the adaptive algorithm to the baseline and an algorithm with perfect foresight. For the algorithms, we compare the DVH of the cumulative dose $D_1+...+D_N$ and the margin needed to achieve a satisfactory cumulative delivered dose.

**Results:** We achieved significant improvement in the objective function while delivering more dose to the tumor and less to the sensitive structures on our test case with setup errors of ±1cm and $\pm 2^{o}$.

**Conclusion:** This new paradigm of adaptive radiation therapy (ART) holds significant promise for us to improve the current radiation therapy.